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The Effect of Wilting on the Feeding Value of Silages 1/

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Ensiling is now a rather widely accepted method of preserving forages for later feeding. The feeding value of silage may logically be compared to that of hay made from the same crop since one method may be substituted for the other to a large extent. However, general comparisons of this type are difficult because consideration must be given to differences in feeding value of either hay or silage resulting from variations in harvesting and storing procedures. The work reported in this paper was initiated to detect to what degree the comparative feeding value of silage and hay might be affected by the extent of silage wilting.

The hays used as a basis of comparison in these experiments were barn dried from the same crops or purchased as U.S. No. 1 alfalfa hay. This procedure assured a relatively critical basis for silage evaluation since good hay is generally considered to have a feeding value difficult to replace by any other form of the same forage.

Experiment 1 - First cutting alfalfa was harvested as direct-cut (20.5% dry matter) and heavily wilted (43.7% dry matter) forages and stored in Harvestore silos. Barn-dried hay was made simultaneously from the same crop. The feeding values of these three feeds for lactating dairy cows were determined during a 120-day feeding trial. The trial was designed as a 3 x 3 Latin Square repeated four times thus using a total of 12 cows. The first ten days of each 40-day period was regarded as a change-over period and the remaining 30 days as the experimental period. Rations consisted of the experimental forage to the extent of appetite and grain initially fed at a grain:FCM ratio of about 1:4 and adjusted each ten days according to the decline in production of all cows. Liveweights were obtained on the last three days of each ten-day period. All milk was weighed and the butterfat content determined each ten days from two-day composite samples. Feeds fed and refused were weighed daily on an individual cow

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basis. The dry matter of forages and refused feed were determined each five days and the dry matter content of grain each ten days.

Dry matter digestibility was determined during the second period of the trial by using the cows which were on each ration at that time. Chromic oxide was fed in the grain for 15 days and fecal grab samples obtained during the last five days of this period.

Values for the average chemical composition of the forages fed are presented in Table 1. Per cent dry matter values in the crop as stored and as fed are not directly comparable since the former represents the entire amount stored and the latter only that portion of the silage utilized in the feeding trial. Little difference existed among forages with respect to proximate analysis constituents. The silage made from heavily wilted forage was higher in dry matter, reducing sugars, and lactic acid content than the direct-cut silage. However, it had a lower content of carotene, ammoniacal nitrogen, acetic acid and butyric acid, and a lower pH. The small amount of total acid and relatively high sugar content of the wilted silage were indicative of a rather limited fermentation.

Results of the feeding trial are summarized in Table 2. Each aspect of animal performance indicated that the feeding value of hay was superior to that of direct cut silage. The feeding value of wilted silage, however, approached but did not equal that of the hay. Dry matter consumption from wilted silage was significantly less than from hay but differences in milk production and liveweight gains were not statistically significant.

More dry matter was consumed per 100 pounds of FCM produced from hay and wilted silage than from direct-cut silage. However, these gross estimates of efficiency are complicated by changes in body energy and different levels of intake. Luxury consumption may reduce the gross efficiency of more palatable feeds when fed on an ad libitum basis. In view of these complicating factors, the gross efficiency values are considered to be of little value except as another indication of relative palatability. The significantly higher digestibility of hay dry matter appears to be in accord with the data from the feeding trial.

Experiment 2 - Second cutting alfalfa was harvested as direct chopped, flail harvested and wilted forages and as barn-dried hay. Forages were stored in conventional concrete tower silos with average dry matter contents of 23.4, 22.4 and 41.9%, respectively.

The cows used for feed evaluation were very heterogenous with respect to freshening date, milk production, appetite, liveweight and level of grain feeding. Therefore, cow groups were balanced on the basis of consumption of U.S. No. 1 alfalfa hay during a pre-experimental period. Feeding values of the four experimental roughages were then measured in terms of voluntary dry matter consumption rates only.

Sixteen cows were used during an 80-day period in a 4 x 4 Latin Square trial repeated four times. Each of the four periods consisted of a 15-day preliminary and a five-day experimental period. Roughage was fed ad libitum and grain rations were adjusted each 20 days on an individual basis so that grain furnished a constant percentage of calculated TDN requirements. Thus percentage of requirements met by grain varied considerably between cows but was the same for rations and periods.

The procedures for obtaining samples of feeds fed and refused were generally similar to those of Experiment 1. The average proximate analyses of the roughages are presented in Table 3. The lower NFE values in all silages are conspicuous. This might be expected to result from respiration and fermentation of readily available carbohydrates and loss of soluble constituents in seepage. Wilted silage appeared to have suffered least in this respect. The average pH value was lowest for wilted silage and highest for direct-cut harvested silage.

Results of the feeding trial are presented in Table 4. Daily dry matter consumption rates have been expressed as pounds per 100 pounds of liveweight and as pounds per cow. Wilted silage was consumed at the highest rate of any of the experimental roughages, followed by barn-dried hay, direct-cut silage and flail harvested silage in that order. Values for consumption of the U.S. No. 1 base hay are not strictly comparable to the experimental roughages since the former were obtained during an earlier period. However, the differences between consumption of the experimental roughages and the base hay are balanced with respect to time of observation thus permitting an unbiased comparison among these differences. Analysis of variance of these differences indicated that wilted silage replaced the base hay in terms of consumption rate better than any of the others and that the experimental hay was much superior to the two unwilted silages in this respect.

SUMMARY AND CONCLUSIONS

The feeding values of alfalfa preserved as wilted and unwilted silage were compared to that of the same crop preserved as barn-dried hay. These feeds were fed ad libitum as the sole roughage. Rate of dry matter consumption, milk production and liveweight changes and digestibility were considered as the criteria of feeding value. The feeding value of wilted silage (45% dry matter) approached that of hay in one experiment and exceeded it in another (52% dry matter). Feeding value of unwilted silages was consistently below that of hay.

It is concluded that (1) wilted silage can approach or equal the feeding value of good hay, (2) crops wilted to the extent necessary to accomplish this can be stored in conventional tower silos, (3) direct-cut harvesting of silage is likely to yield a product of considerably lower feed value than wilted silage or hay, (4) general statements concerning the relative feed values of silage and good hay have very limited application because of the within silage variability associated with wilting.

Table 1.--Chemical analysis of 1958 first cutting alfalfa when fed, dry matter basis

Chemical Fractions	Type of Preservation		
	Direct chopped silage	Wilted silage	Barn dried hay
Dry Matter %	24.1	45.5	90.6
Crude Protein %	18.6	17.8	18.2
Ether Extract %	2.4	2.1	1.5
Crude Fiber %	33.2	31.5	30.8
NFE %	37.6	38.7	40.1
Ash %	8.2	9.9	9.4
Sugar %	0.1	3.7	
Carotene ppm	199.	84.	
pH	4.9	4.6	
Ammoniacal Nit.1/	20.6	8.1	
Butyric Acid %	1.4	0.1	
Propionic Acid %	0.9	0.0	
Acetic Acid %	6.1	1.4	
Lactic Acid %	0.7	1.9	

1/ Expressed as percent of total nitrogen.

Table 2.--Feeding value of 1958 first cutting alfalfa.

	Direct cut silage	Wilted silage	Barn dried hay
Dry matter consumed lb./cow/day:			
Silage	17.83^{A}	22.16^{Ba}	24.56^{Bb}
Grain	6.45	6.42	6.26
Total	26.28	28.58	30.82
Dry matter consumed lb./cwt/day:			
Silage	1.81^{A}	2.16^{B}	2.41^{C}
Grain	.66	.63	.61
Total	2.47	2.79	3.02
FCM per cow daily:			
Average yield, lb.	24.56^{Aa}	25.94^{Aab}	27.13^{Ab}
10 day regression, lb.1/	-1.53^{A}	-1.05^{Ba}	-1.10^{Ba}
Ratio, grain:FCM	1:3.8	1:4.0	1:4.3
Liveweight per cow			
Average, lbs.	983	1026	1019
10 day regression, lb.2/	-8.75^{A}	$+4.83^{Ba}$	$+7.82^{Ba}$
Lb. silage D.M. per cwt. FCM	72.6	85.4	90.5
Dig. Coef., Silage D.M.	557^{Aa}	56.3^{Aa}	61.2^{Ab}

1/ Regression of FCM produced 10-20, 20-30 and 30-40 days following ration change.

2/ Regression of liveweight at 10,20,30 and 40 days following ration change.

A,B,C - Means not followed by the same capital letter are different at 1% level.

a,b - Means not followed by the same small letter are different at 5% level.

Table 3.--Chemical analysis of 1958 second cutting alfalfa as fed dry matter basis.

	Dry Matter	Dry matter constituents					
		Crude Protein	Ether Extract	Crude Fiber	N.Free Extract	Ash	pH
	%	%	%	%	%	%	
Wilted silage	52.1	18.0	1.8	35.4	36.4	8.4	4.8
Flail harvested silage	23.8	15.1	2.9	39.8	33.4	8.8	4.9
Direct-chopped silage	23.8	17.0	3.5	37.4	33.2	8.9	5.1
Barn-dried hay		16.2	1.2	33.0	41.9	7.7	

Table 4.--Feeding value of 1958 second cutting alfalfa.

		Experimental Roughages			
	Base hay	Barn-dried hay	Wilted silage	Flail harvested silage	Direct-cut silage
Ave. L.W. per cow	1076	1087	1102	1070	1071
Alfalfa D.M. cons. per cwt.	2.378	2.222	2.404	1.674	1.770
Alfalfa D.M. cons. per cow daily	25.59	24.15	26.49	17.91	18.96
Difference in D.M. cons. compared to base hay		- 1.44^{Ab}	+ .90^{Aa}	-7.68^{Bc}	- 6.63^{Bc}

A - Means not followed by the same capital letter are different at 1% level.

a,b,c - Means not followed by the same small letter are different at 5% level.